

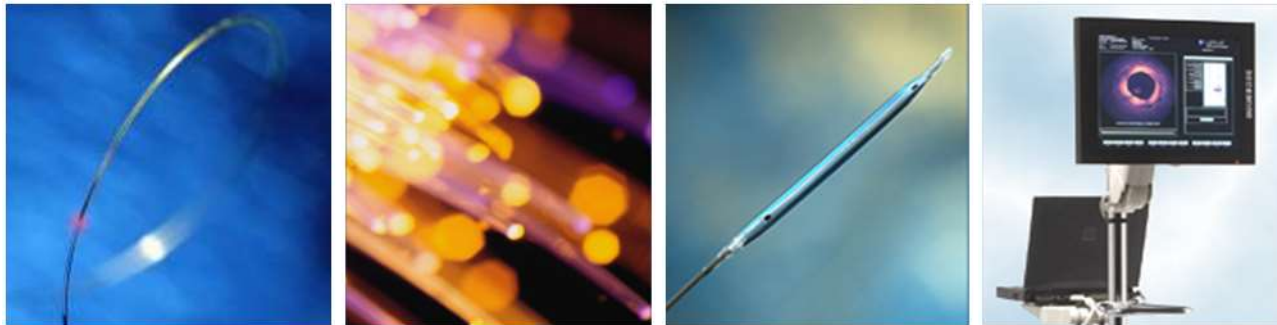
8th Imaging and physiology summit 2015

Dec/5/2015 10:58-11:06

Grand Intercontinental Seoul Parnas, Main Arena, Level 5
Seoul, Korea

Part I: Intracoronary Imaging Update
New Imaging Technology: State-of-the-Art

Plaque Assessment **by Combined OCT-Spectroscopy**



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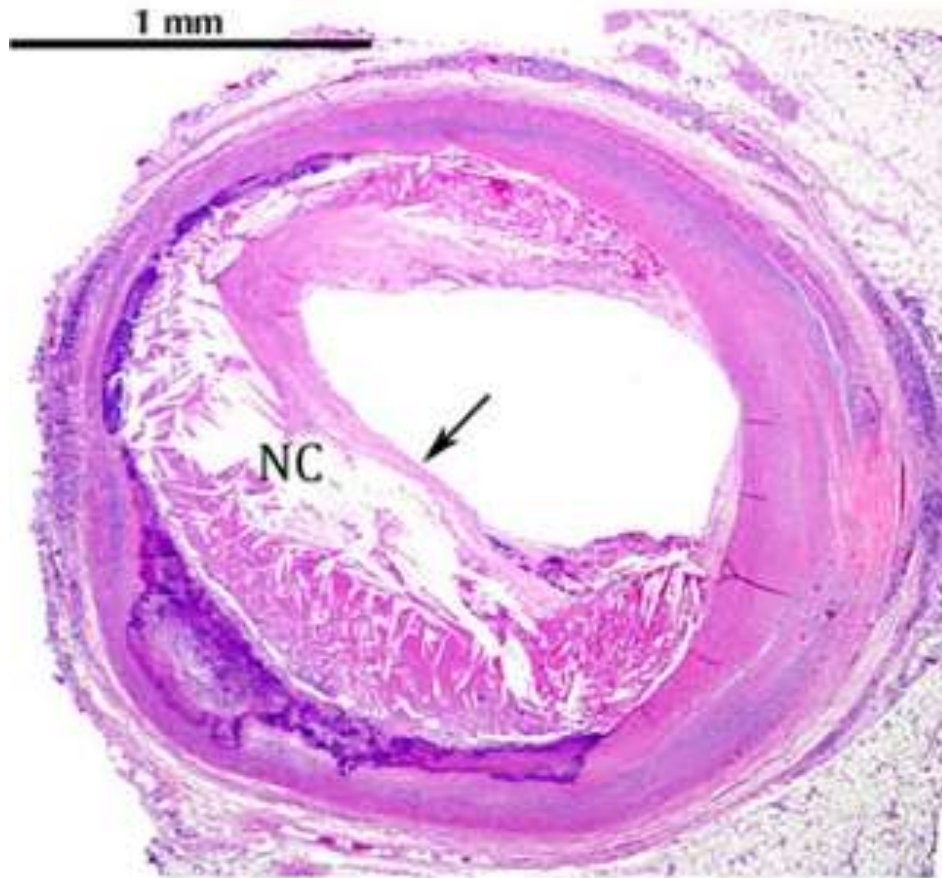
Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

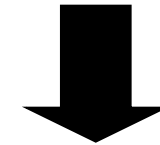
Affiliation/Financial Relationship	Company
• Grant/Research Support	• St. Jude Medical, Terumo, Abbott Vascular
• Consulting Fees/Honoraria	• St. Jude Medical, Terumo, Sumitomo elec.
• Major Stock Shareholder/Equity	• No
• Royalty Income	• No
• Ownership/Founder	• No
• Intellectual Property Rights	• No
• Other Financial Benefit	• No



Lipid: an important feature of atheroma



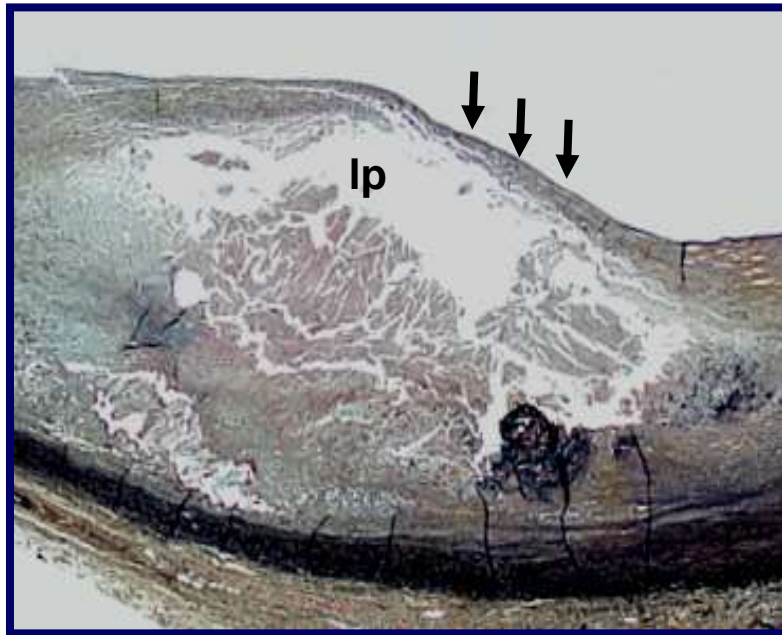
Thin-capped fibroatheroma (TCFA)



- Large lipid necrotic-core
- Thin fibrous cap $<65\mu\text{m}$
- Macrophages
- Eccentric plaque
- Positive remodeling

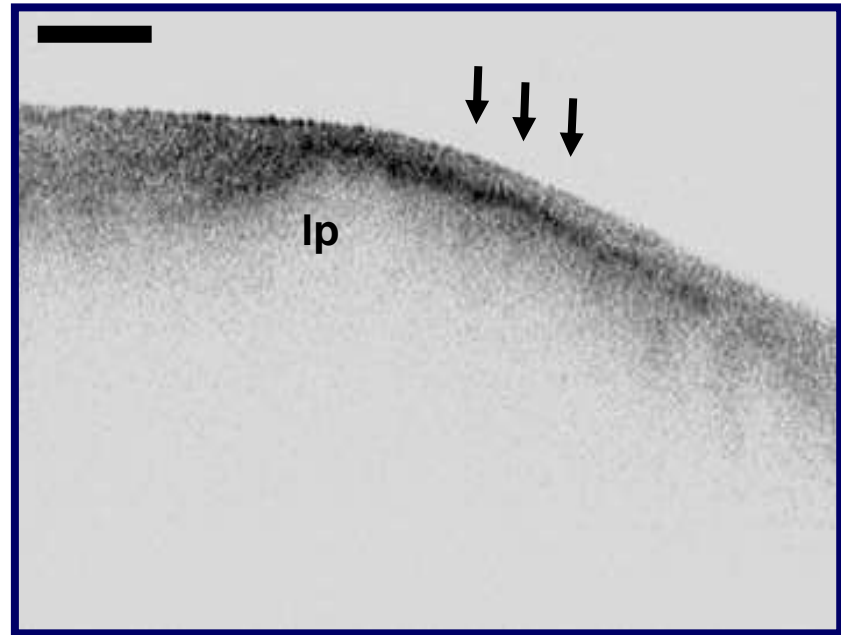
OCT

Histology



Lp = lipid

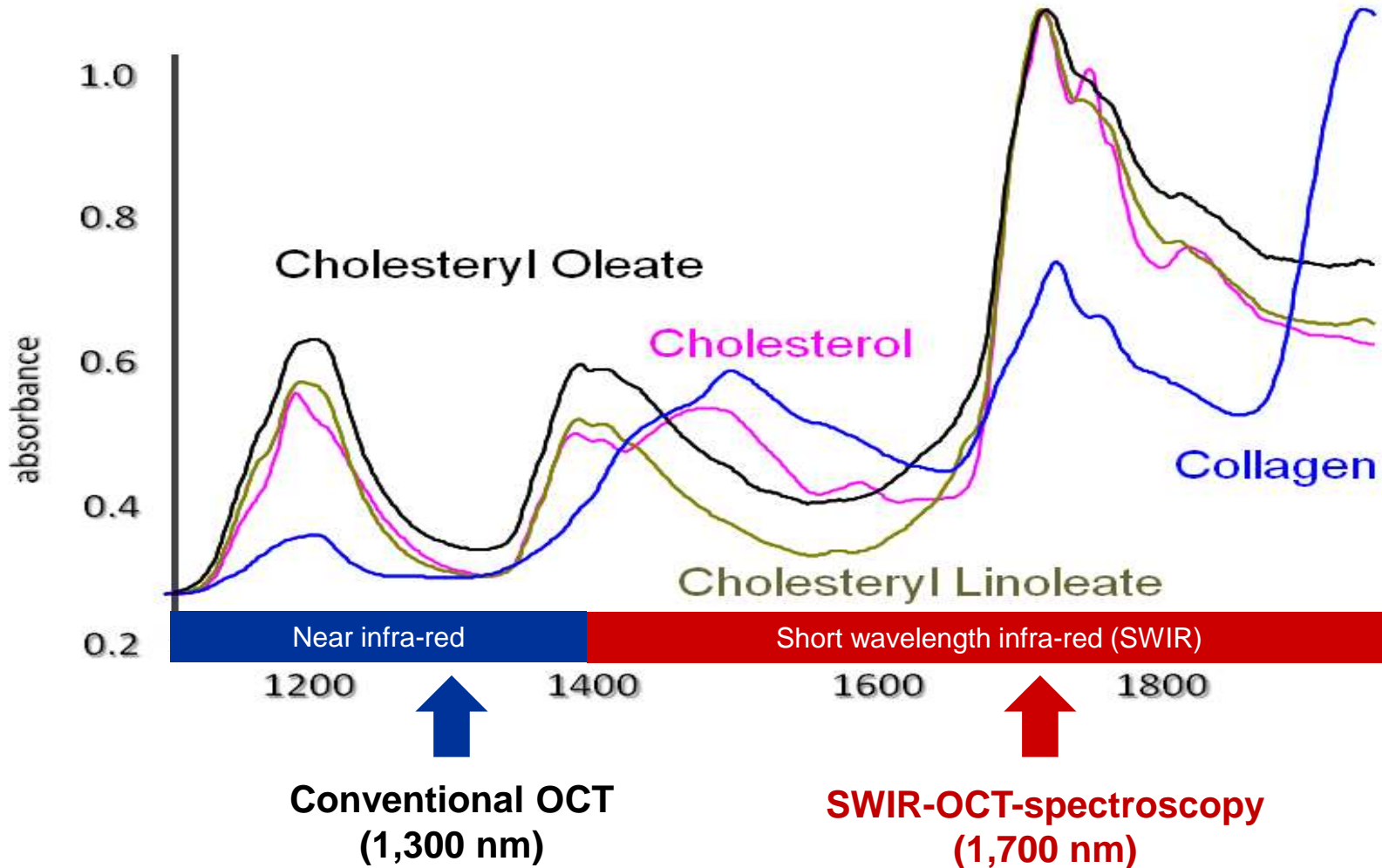
OCT



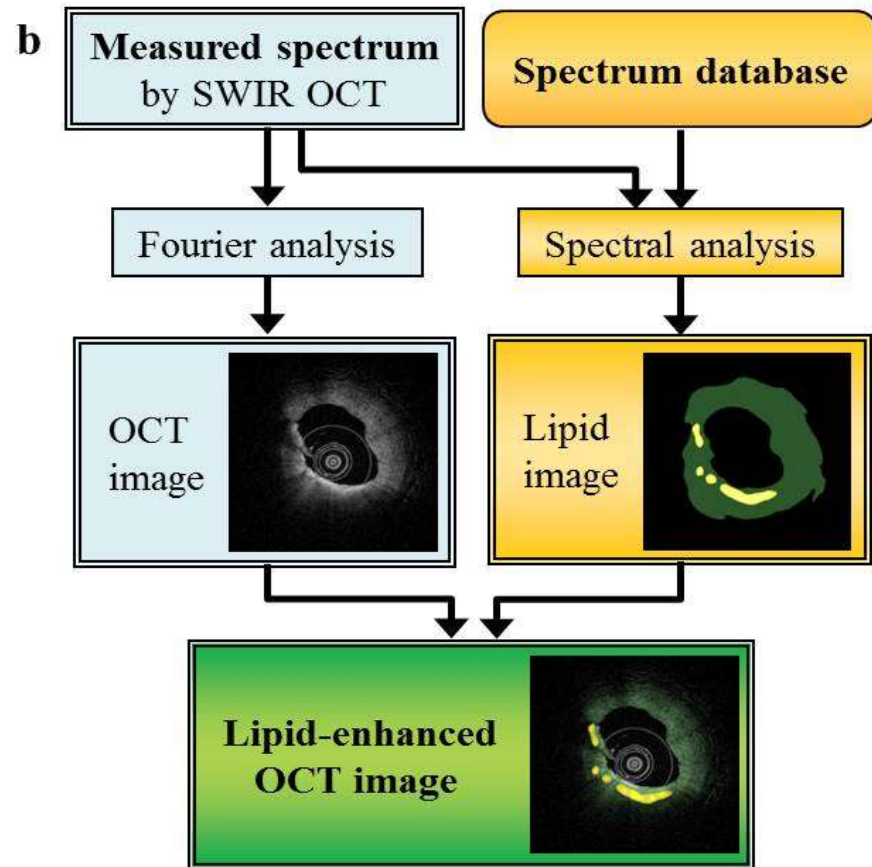
Echo-lucent zone with diffuse border

- Conventional OCT can identify lipid tissue within plaque.
- But it is subjective and its accuracy depends on proficiency of physician.

Light absorption in cholesterol and collagen

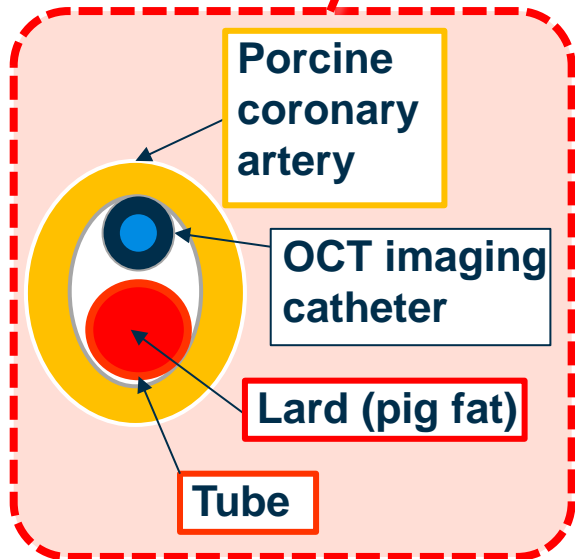
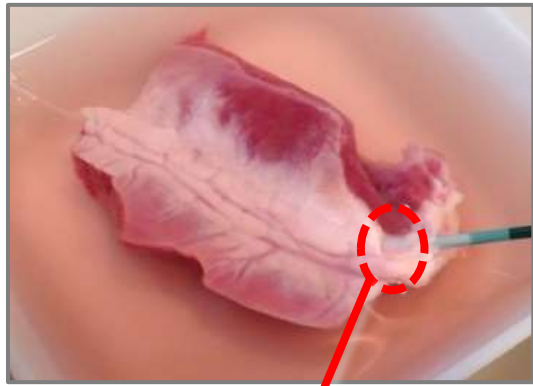


A novel SWIR-OCT-spectroscopy system

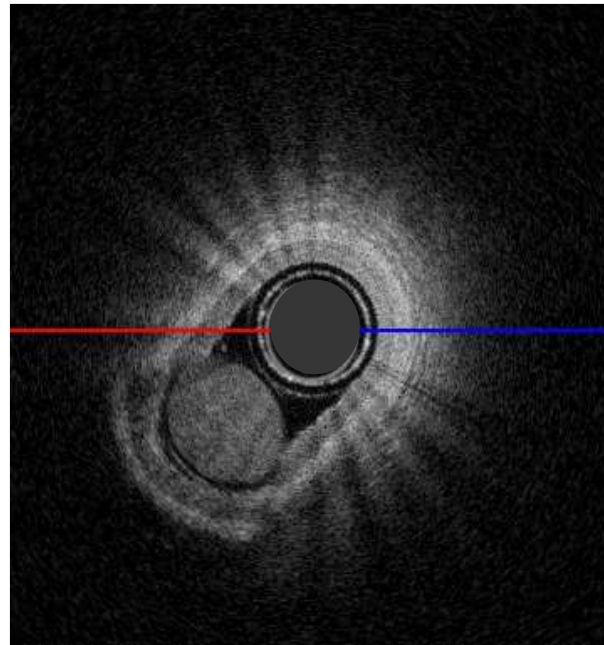


Prototype SWIR-OCT system (Sumitomo Electric Industries, Ltd., Japan) (a) and software flow chart (b). The system measures spectrum of the artery under test at 1,700 nm wavelength band. Fourier analysis on the spectrum generates a standard OCT image and a spectral analysis generates a lipid distribution image, which is superimposed on the OCT image resulting in a lipid-enhanced OCT image.

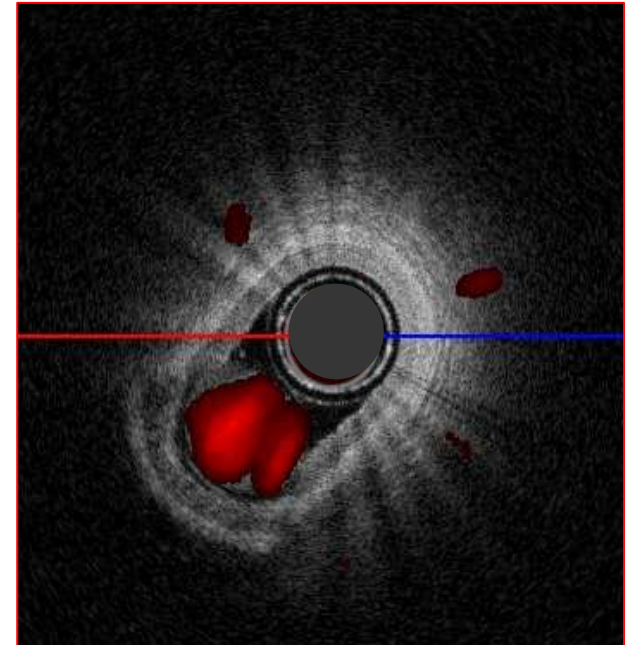
SWIR-OCT-spectroscopy: in Porcine model



OCT image



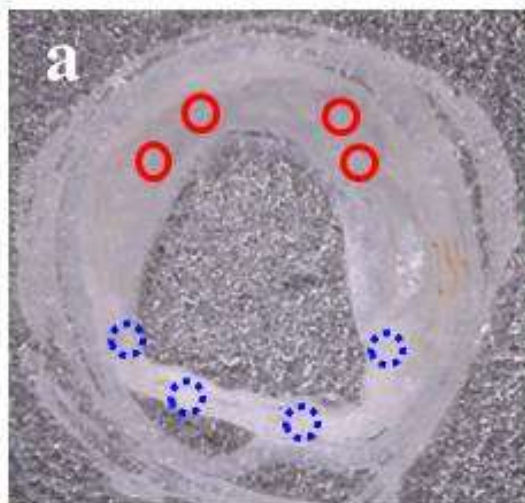
Lipid-enhanced OCT image



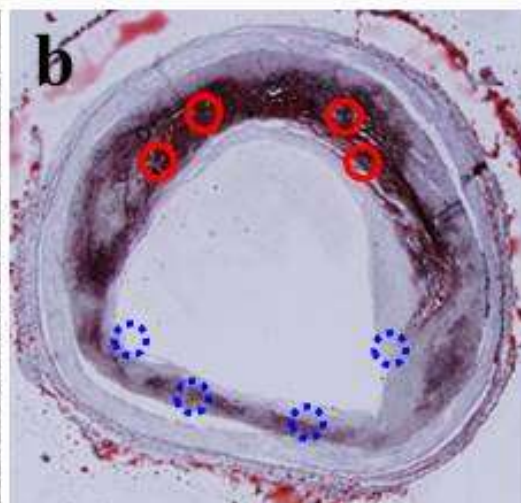
Sensitivity = Specificity = 92%

Light spectral feature of lipid: 1,300 nm near-infrared wavelength bands

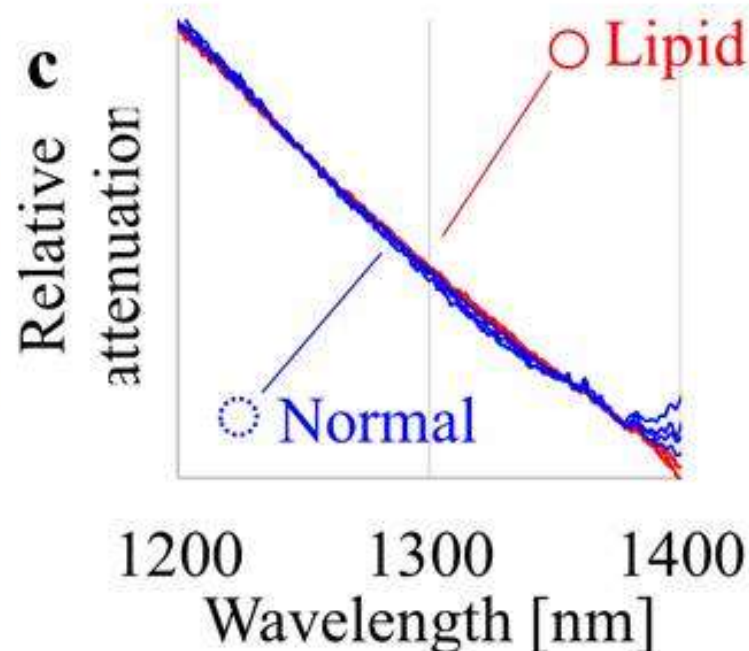
Human autopsy coronary artery



Unstained section



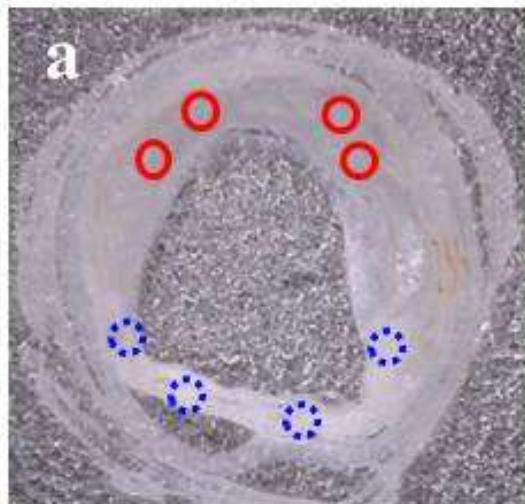
Oil Red O stained section



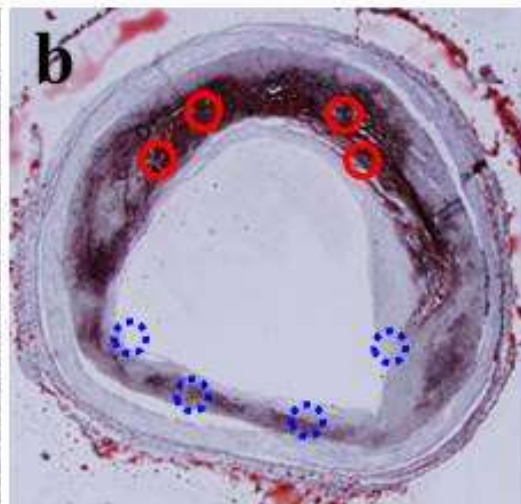
Light attenuation spectra were measured for the chosen 4 lipids and 4 normal points using a spectrometer. (c) Light spectral feature was not difference between lipids and normal points in 1,300 nm near-infrared wavelength bands.

Light spectral feature of lipid: 1,700 nm near-infrared wavelength bands

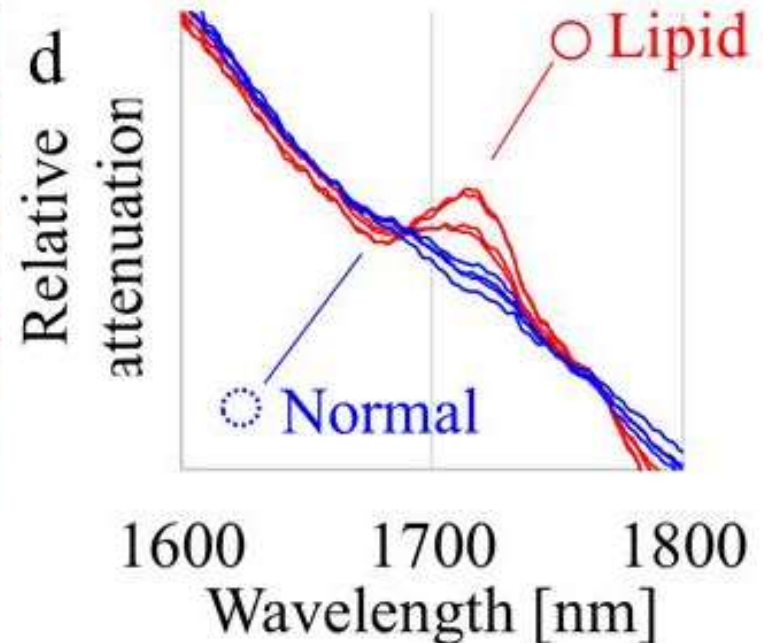
Human autopsy coronary artery



Unstained section



Oil Red O stained section



Light attenuation spectra were measured for the chosen 4 lipids and 4 normal points using a spectrometer. (c) **Lipid has characteristic attenuation peak in 1,700 nm SWIR wavelength bands.**

SWIR-OCT spectroscopy

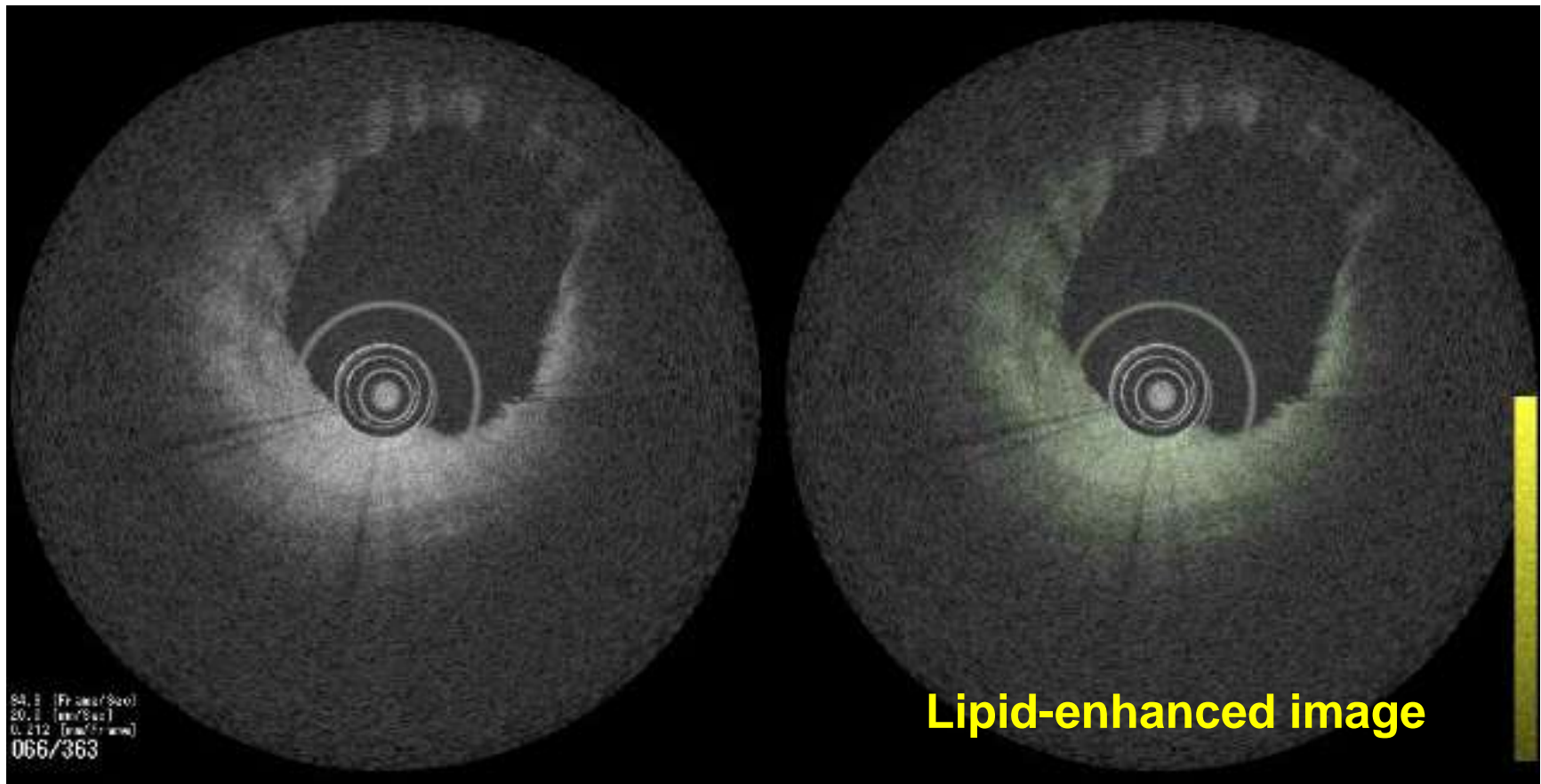
SWIR = Short wavelength infrared

Conventional OCT

(Wave length = 1,300 nm)

SWIR-OCT spectroscopy

(Wave length = 1,700 nm)



Lipid-enhanced image

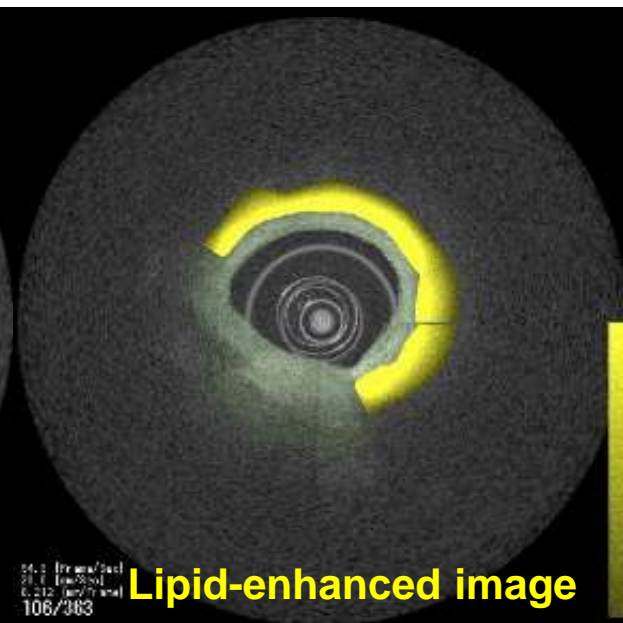
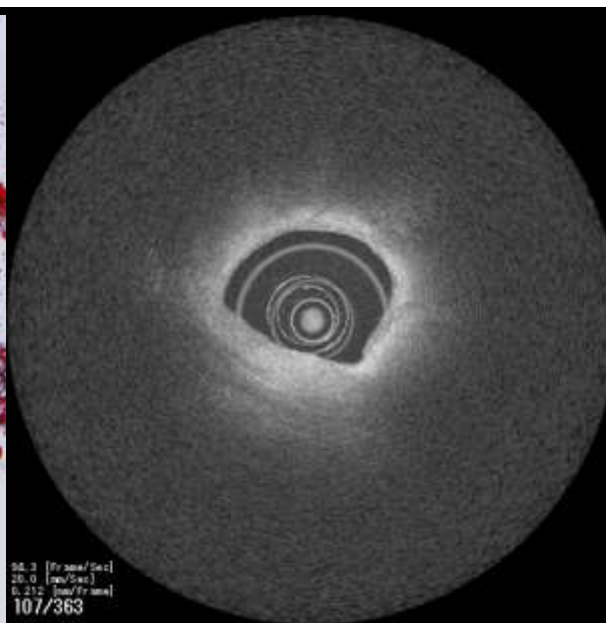
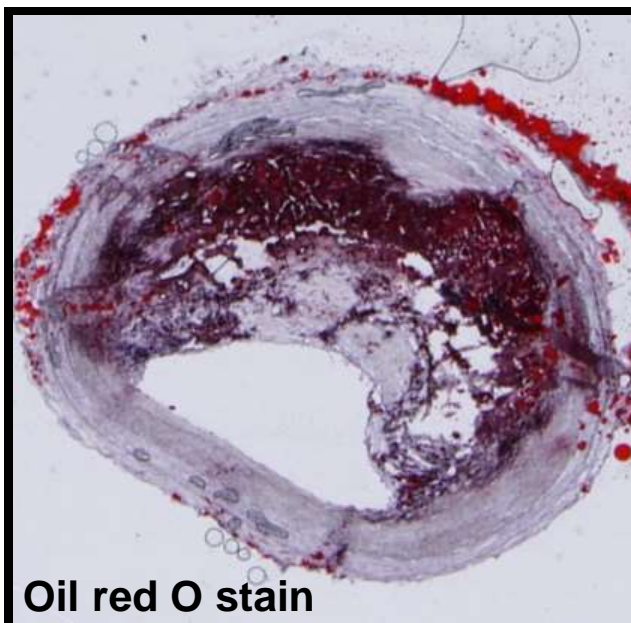
SWIR-OCT spectroscopy

SWIR = Short wavelength infra red

Histology

Conventional OCT

SWIR-OCT spectroscopy



Lipid enhance image of SWIR-OCT spectroscopy showed lipid with yellow color, which almost coincided with Oil Red O. SWIR-OCT spectroscopy can identify lipid plaque accurately.

Accuracy of SWIR-OCT spectroscopy for lipid detection

		Histology		Total
		Lipid (+)	Lipid (-)	
SWIR-OCT spectroscopy	Lipid (+)	99	3	102
	Lipid (-)	11	26	37
Total		110	29	139

Sensitivity 90%

Specificity 90%

Positive predictive value 97%

Negative predictive value 70%

Conclusion

- We developed a novel SWIR-OCT spectroscopy system to detect lipid tissue automatically.
- SWIR-OCT spectroscopy accurately identified lipid tissue in human coronary autopsy specimens.
- This new technique may hold promise for identifying a histopathological feature of coronary plaque at risk for rupture.

Thanks for your attention !

